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Review article

Glenoid labrum pathology



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ABSTRACT

The glenoid labrum is the fibrocartilage of the shoulder joint, anchoring the joint capsule and shoulder ligaments. Morphology varies regionally, especially in the superior and anterior region; these variants can sometimes be confused with pathological aspects. The labrum is often involved in shoulder pathology, by single trauma or, more often, repeated microtrauma. It seems logical to classify and to describe tears according to two criteria: the sector involved, and associated pain or instability. In the superior labrum, SLAP lesions are the most frequent. These combine labral lesion and lesion of the proximal insertion of the long head of the biceps brachii tendon. The most frequent form is SLAP II. They may be associated with instability or not. In the antero-inferior and postero-inferior labrum, lesions are mainly due to instability, particularly Bankart lesions (capsulolabral avulsion) anteriorly and Kim's lesion posteriorly. Circumferential labral lesions may be found in unstable shoulder. Finally, postero-superior lesions involve Walch's internal impingement: repeated contact between the deep surface of the cuff and the labrum, which takes on a degenerative aspect, with a kissing lesion of the cuff. There is no general rule for management: some labral lesions are resected and others fixed. The cause (which is usually shoulder instability), however, needs to be assessed and treated.

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1. Introduction

For anatomical reasons and in view of the lesions encountered, the present study has to include lesions of the proximal insertion of the long head of the biceps brachii tendon.

For the purposes of describing the various glenoid labrum lesions, they are first classified according to location in the 6 glenoid sectors, following Snyder [1] (Fig. 1). They are then classified according to clinical presentation or main presenting symptom: pain or instability.

2. Normal labrum anatomy and biomechanics

2.1. Anatomy

The glenoid labrum is the fibrocartilage of the shoulder joint.

It comprises 3 sides and 1 edge: the superficial side is free and responsive to the humeral head; the articular side adheres, to a greater or lesser degree according to area, to the edge of the glenoid cavity; and the peripheral side is in continuity with the joint capsule

(providing vascularization) and the shoulder ligament insertion. The axial edge is free.

The form varies according to region:

- the articular side does not adhere to the edge of the glenoid cavity in the superior region, where it is free (meniscus-like aspect);
- it is wide, voluminous and adheres to the edge of the glenoid cavity in the inferior and posterior region (region of the inferior glenohumeral ligament insertion, on which the strongest forces act [2]).

The insertion of the long head of the biceps brachii tendon is to both the supraglenoid tubercle and the superior part of the labrum. The proportion and orientation of biceps fibers involved in the labrum vary greatly between individuals [3].

2.2. Anatomic variants

The main variants occur in sectors 1 and 2.

2.2.1. Superior region, or sector 1

This is probably the area with the most anatomic variants. In young subjects, the labrum adheres strongly to the edge of the glenoid cavity, but with age, a recess develops, although this is not

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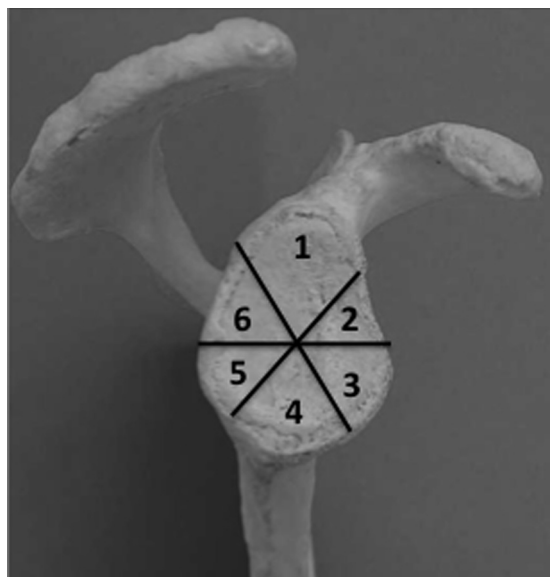


Fig. 1. View facing glenoid cavity. Snyder's subdivision in 6 sectors.

pathological [3]. It is certainly normal as long as there remains joint cartilage up to the most peripheral insertion of the labral fibers.

2.2.2. Anterosuperior region, or sector 2

Here again there are many anatomic variants, more or less related to age. Normally, the labrum is rounded, and mobile with respect to the edge of the glenoid cavity (sublabral or Weitbrecht's foramen).

The most frequent variants are: free (13.5%) or no labrum and narrow, "cord-like" middle glenohumeral ligament (MGHL) in continuity with the biceps footplate (Buford complex) (12%) [4].

2.3. Biomechanics

The labrum has several functions, and 3 in particular:

- it increases the contact area between humeral head and scapula, by 2 mm anteroposteriorly and 4.5 mm supero-inferiorly;
- it contributes to the "viscoelastic piston" effect, maintaining -32 mmHg intra-articular negative pressure; this is especially effective against traction stress and, to a lesser extent, against shear stress [5];
- it provides insertion for stabilizing structures (capsule and glenohumeral ligaments), as a fibrous "crossroad". Labrum and ligaments are in synergy in a genuine complex, each structure's contribution varying with the position of the limb: in abduction and external rotation (ABER), the inferior glenohumeral ligament (IGHL) absorbs 51% of the stress, the superior glenohumeral ligament (SGHL) 22% and the MGHL 9% [6].

3. Labral lesions

In stable shoulder, labral lesions essentially occur in sector 1 (labral-bicipital complex), and rarely in sectors 4 or 5, contributing to a context of instability.

3.1. Sector-1 superior labral tear

These are mainly, but not exclusively, labral-bicipital complex lesions, known as SLAP (superior labrum antero-to-posterior) tear [1,7].

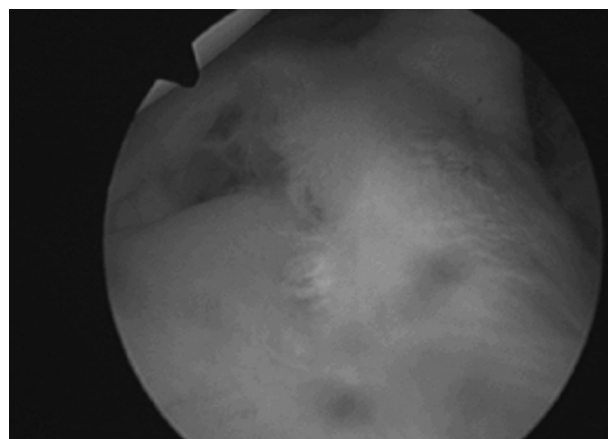


Fig. 2. Arthroscopic view of a left shoulder. Type-II SLAP lesion: avulsion of superior labrum and the insertion of the long head of the biceps brachii tendon.

3.1.1. SLAP

SLAP tear itself accounts for 80–90% of labral pathology in stable shoulder, but is found in only 6% of shoulder arthroscopies [8]. Interpretation remains controversial: is it a real lesion or not?

Some authors have reported risk factors: labral dysplasia (Buford complex), scapular hyperlaxity and dyskinesia (the "SICK scapula syndrome": scapular malposition, inferior medial scapular winging, coracoid tenderness, and scapular dyskinesia) [4].

Type-I SLAP tear: this is a degenerative lesion, fraying the free edge of the labrum. The insertion to the edge of the glenoid cavity is unaffected, and pathologic status is debatable.

Type-II SLAP tear (Fig. 2): this consists in the labrum and long head of the biceps brachii tendon being torn from the glenoid cavity. Arthroscopy finds a highly mobile labral-bicipital complex, with an inflammatory area without cartilage under the avulsion area. It is this absence of cartilage and/or highly inflammatory aspect of the articular side of the labrum that differentiates it from meniscus-like labrum.

Type-III SLAP tear (Fig. 3): this is a "bucket-handle" detachment of the superior labrum, not involving the labral insertion of the long head of the biceps brachii. It is probably the rarest form.

Type-IV SLAP tear (Fig. 4): this is a type-III SLAP extending to the long head of the biceps brachii. In unstable shoulder, it is frequently associated with anterior labrum tear [7].

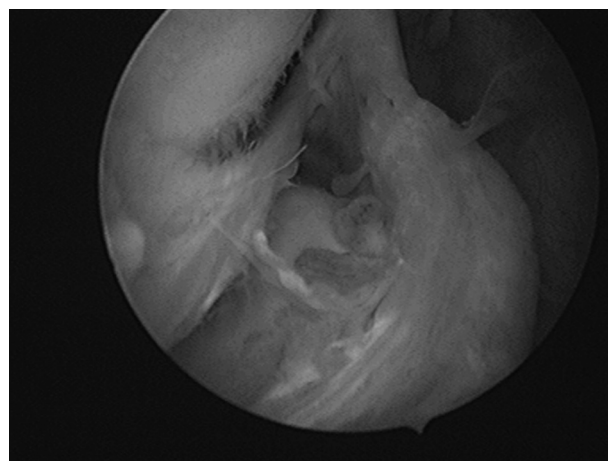


Fig. 3. Arthroscopic view of a left shoulder. Type-III SLAP lesion: bucket-handle lesion of the superior labrum.

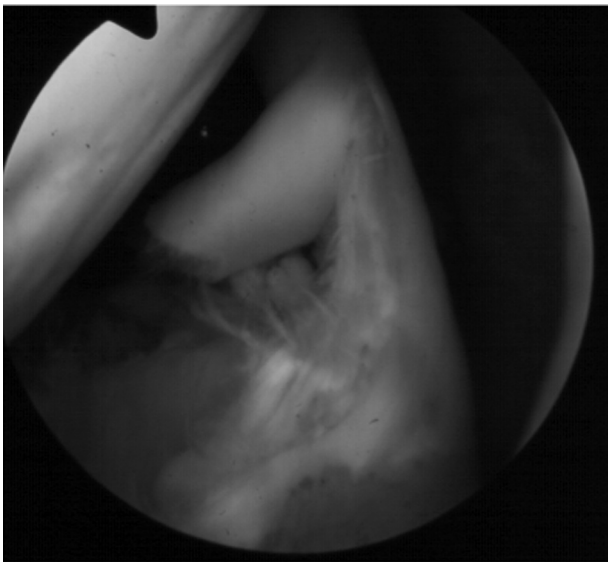


Fig. 4. Arthroscopic view of a left shoulder. Type-IV SLAP lesion: extension of the lesion to footplate of the long head of the biceps brachii tendon.

Type-V SLAP tear: this is a type-II tear associated with anterior instability, and will be dealt with in the section on labral lesions in unstable shoulder.

Type-VI SLAP tear: this comprises large superior labral flaps without detachment of the biceps insertion. Incidence is unknown.

Type-VII SLAP tear: here, there is superior labrum detachment (SLAP type-II) prolonged by middle and inferior glenohumeral ligament tear. It is an extended instability lesion.

Type-VIII SLAP tear: recently described by Choi and Kim [9], type-VIII SLAP is a type-II tear also involving the cartilage adjacent to the biceps footplate (“chondro-labro-bicipital monoblock” SLAP tear).

3.1.2. Other superior labral tears: Andrew's lesion

Andrew's lesion is mainly found in throwers (Fig. 5). It consists of pure superior labrum detachment without extension posterior to the biceps footplate (thus not to be confused with SLAP type-II).



Fig. 5. Arthroscopic view of a left shoulder. Andrews' lesion: detachment of the anterior and superior labrum without extension posterior to the biceps brachii insertion.

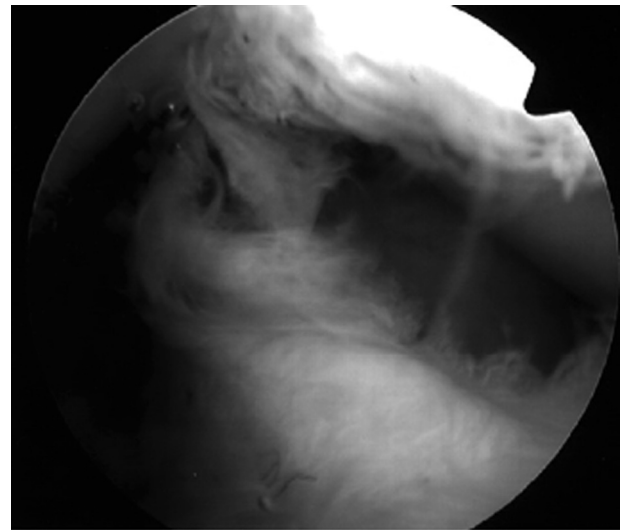


Fig. 6. Arthroscopic view of a right shoulder. Walch's internal impingement lesion: delaminated labrum and a kissing lesion of the deep surface of the cuff.

Arthroscopy finds a labral flap; interposition in the joint line causes pain and snapping [10].

3.2. Sector 2 anterior labral tear

Described by Terry et al. [11], this is a purely anterior labral tear associated with an MGHL tear (usually longitudinal; detachment is possible). It is rare, and can be hard to distinguish from non-adherent labrum (sublabral foramen) or Buford complex.

3.3. Sector 6 posterior labral tear

Posterior tear is much less frequent than anterior tear. It may occur in stable or in unstable shoulder.

In stable shoulder, it is caused by Walch's internal impingement [12,13] (Fig. 6). It associates labrum tear and partial tear of the rotator cuff joint face at the supra/infraspinatus junction. Walch considers the labrum-cuff contact to be physiological; even so, iterative microtrauma can lead to degenerative labral lesions [12]. The labrum tear may extend as far as the biceps brachii tendon footplate (SLAP II). The supraspinatus is held by forceps, between the labrum and the humeral head, with the limb in ABER (peel-back). Such tears are common in throwers [14,15].

Various contributive factors have been reported, such as lack of humeral retroversion, anterior capsule insufficiency, or postero-inferior capsule contracture.

3.4. Sector 3 and 4 anterior and antero-inferior labrum tear

These lesions are typical of acute or chronic anterior shoulder instability. Several forms are encountered, from simple avulsion to abnormal cicatrization positioning.

Ligamentous (IGHL and MGHL) tear and/or bone lesion of the antero-inferior edge of the glenoid cavity are frequently associated, in which case the following forms are distinguished:

- Perthes lesion: antero-inferior labrum detachment without displacement or associated lesion;
- GLAD (Gleno-Labral Articular Disruption) [16]: this rare lesion consists of superficial detachment or fissuring of the anterior and inferior labrum, with adjacent cartilage defect (passing lesion) but no IGHL lesion. It results from humeral head impaction on the edge of the glenoid cavity;

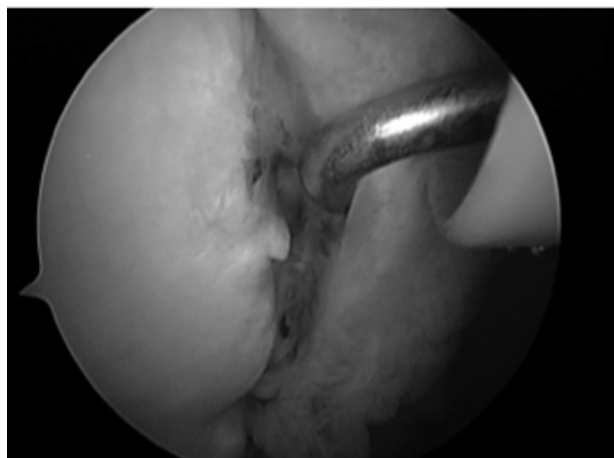


Fig. 7. Arthroscopic view of a right shoulder. Isolated Bankart lesion: labro-periosteal anterior flap.

- Bankart lesion and Broca-Hartmann pouch: there is anterior detachment of the capsule and labrum, in continuity with the anterior periosteum of the scapular neck [17,18] (Fig. 7). This may occur as of the first episode of instability [19], and in 72% of cases is associated with bone lesion of the anterior edge of the glenoid cavity and in 90% with a humeral notch [19,20]. It is caused by detachment of the MGH and IGH from the glenoid [17]. It may fail to heal, leading to risk of recurrent dislocation. It is almost systematically associated with either plastic deformity of the anterior capsule or humeral avulsion of the IGH (HAGL, or BHAGL lesion if associated with a bone fragment) [21]. Prognosis following the first instability episode mainly depends on associated lesions [22]. Arthroscopy is less effective than X-ray in assessing their severity. There is superior extension in 26–33% of Bankart lesions, which are in that case SLAP type-V [7]. As such associations are not exceptional, it seems essential, when apparently isolated SLAP is discovered, to explore on arthroscopy for instability lesions overlooked on peroperative clinical and paraclinical examination. Inferior-posterior extension may also be found (i.e., into sector 5) in 8% of cases, generally associated with severe humeral notching [23]. In 6% of cases, extension may even be circumferential [23].
- ALPSA lesion: a Bankart lesion may heal too medially, on the scapular neck: this is the anterior labroligamentous periosteal sleeve avulsion described by Neviaser [24]. The IGH is distended, and thus non-functional. The labral ring is torn, with loss of anterior buffer function. ALPSA is an important factor in failure of arthroscopic shoulder stabilization [25].

3.5. Sector 5 and 6 posterior and postero-inferior labral tear

These are found in case of posterior instability, which is rare, with about 2% incidence in the general population. The capsulolabral lesion is postero-inferior [26], and sometimes referred to as “reversed Bankart lesion” by analogy to the antero-inferior anterior instability lesion. It is rarely isolated, concomitant postero-inferior cartilage damage often being found.

Kim’s lesion (Fig. 8) consists of posterior capsulolabral and periosteal detachment with a plate of adjacent cartilage torn away [27]. Typically, the position is between 6 and 9 o’clock. In case of multidirectional instability, there is an associated circumferential labral lesion. Prognosis depends on the extent of the cartilage lesion.

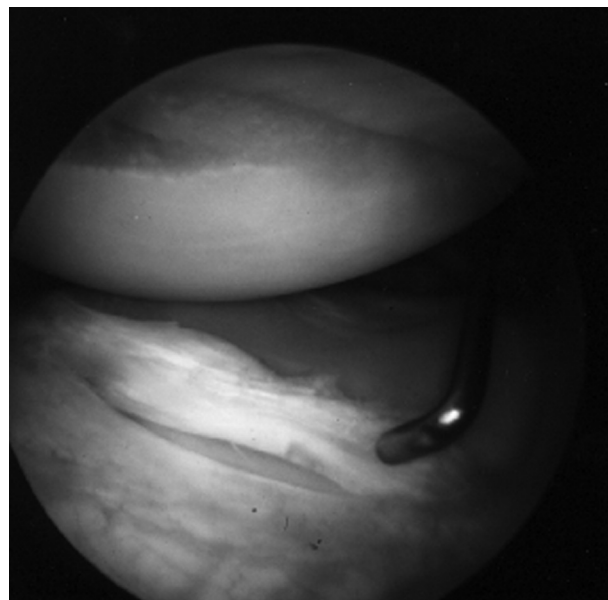


Fig. 8. Arthroscopic view of a right shoulder. Posterior concealed avulsion of the labrum or Kim’s lesion.

4. Symptoms and treatment of glenoid labrum lesions

The presenting complaint in labral lesion is either pain or instability (which may have associated pain). In either case, interview and clinical examination are insufficient for diagnosis, which requires imaging.

4.1. Labral imaging

The imaging examination presently most widely used is CT arthrography [28], with sensitivity of 94–98% and specificity of 73–88% in lesions of the labral-bicipital complex.

It is, however, MRI and MR arthrography that appear as the reference examinations in the english-language literature. Their respective sensitivities and specificities differ, in favor of MR arthrography: in non-unstable labral lesions, MR arthrography has 91–98% specificity and 82–89% sensitivity, and likewise in Bankart lesions.

The main advantage of CT arthrography over MR arthrography lies in the assessment of associated bone lesions (notably on the anterior edge of the glenoid cavity).

The ABER position enhances examination sensitivity by IGH tension.

4.2. Painful forms

It is mainly sector-1 tears that cause pain, which is anterior, disabling and inflammatory.

Interview reveals one of 3 main mechanisms: single compression trauma of the labral-bicipital complex caused by the humeral head [1]; single traction trauma [29]; or iterative microtrauma in peel-back position [30].

The real issue, however, is to distinguish between labral tear and biceps footplate pathology, upon which treatment depends.

4.2.1. Clinical examination

Range of motion in anterior, internal and external elevation is unrestricted.

There are a large number of more or less reproducible and above all specific clinical tests for sector-1 labral lesions.

The literature is difficult to analyze, as few studies have sufficient levels of evidence.

The most useful analysis of the various tests is that reported by Munro et al. in 2009 [31]. Only 6 maneuvers proved reliable for assessing the superior part of the labrum: the relocation test, the biceps load tests (I and II), the internal rotation resistance test (IRRT), the crank test, Kim's test, and the jerk test.

Relocation test: for diagnosing sector-6 tear: i.e., Walch's internal impingement. With the patient standing, pain is elicited by maximal external rotation and abduction and disappears with the relocation maneuver: the examiner pushes the humeral head forward, reducing posterior stress and relieving the pain.

Biceps load tests (I or II): for diagnosing SLAP lesions. Test I is performed with the patient supine, arm in 90° abduction, without elevation; lateral rotation is induced up to the point where the patient reports apprehension; the patient then flexes the elbow against resistance. The test is positive if apprehension is elicited or the pain reproduced, and negative if apprehension and pain improve or remain unchanged. In test II, the principle is the same, but with 120° anterior elevation.

IRRT: for differentiating from subacromial impingement. The patient is standing, in peel-back position, with the examiner behind. The test is positive if external rotation force is conserved and internal rotation force reduced, in which case there is very probably intra-articular lesion rather than subacromial impingement.

Kim's test: for diagnosing postero-inferior tear. The patient is seated with the arm in 90° abduction; axial compression is applied, then the arm is placed in 45° elevation, maintaining the axial pressure and thus compressing the postero-inferior structures. The test is positive if it triggers sharp pain, with or without snap.

Jerk test: for diagnosing postero-inferior tear. The patient is seated, with the examiner behind, stabilizing the scapula; the arm is placed in 90° abduction and 90° internal rotation; the examiner exerts axial pressure and brings the limb into adduction. The test is positive if it triggers sharp pain, with or without snap.

Crank test: for diagnosing labral lesion. The patient is standing, in maximal anterior elevation in the scapular plane; the examiner exerts a force in the humeral axis with one hand, bringing the humerus into rotation with the other. The test is positive if symptomatology is reproduced, with or without snap. The weak point of this test is that it does not locate the lesion.

The sensitivity and specificity of other tests (active compression test, O'Brien's test, forced abduction test, speed test, etc.) do not warrant recommendation for current practice.

4.2.2. Treatment

It is indispensable to be aware of variants, mainly in sector 1, as reinsertion should never be attempted in Buford complex.

In SLAP lesions, the choice between suturing the tear versus tenodesis of the long head of the biceps brachii tendon is a matter of debate.

In flap or bucket-handle tear, treatment may be simple resection of the bucket-handle. It is essential to check the stability of the biceps footplate insertion after resection. Tenodesis (tenotomy) is the final and probably most effective option [32,33].

According to French Arthroscopy Society guidelines [32]:

- superior labral lesions can be sutured in athletic under 20 years old;
- otherwise, biceps tenodesis and tenotomy should be proposed.

In Walch's internal impingement, management is firstly by rehabilitation: postero-inferior capsule stretching exercises under the supervision of a physical therapist, before undertaking reinforcement of the external rotator and scapula stabilizer muscles. In

case of failure, surgery should be proposed. Lévine glenoidplasty [15] is the only procedure providing satisfactory results.

4.3. Forms involving instability

4.3.1. Clinical examination

In case of anterior instability, 3 structures may be affected: the glenoid cavity, the joint capsule or the humeral head. Preoperative clinical and radiological assessment underlies lesion analysis.

Initial clinical examination in recurrent anterior instability looks for apprehension. With the patient in dorsal decubitus to stabilize the scapula, the arm is brought into 90° abduction and progressively into external rotation, with axial compression of the humeral head onto the glenoid cavity. Subluxation of the humeral head with a sensation of catching or snapping, resembling the jerk test in the knee, indicates instability, whether antero-inferior or posterior; above all, the patient feels a discomfort and asks for the maneuver to be halted. Relocating the humeral head by posterior pressure on the proximal humerus brings relief (relocation test).

Three signs of instability and laxity are to be explored: increased external rotation at 90° abduction (ER2) as compared to the presumed healthy contralateral shoulder; Gagey sign; and sulcus sign in external rotation elbow-to-body (ER1).

ER2: in Bankart lesions, ER2 tends to be greater than in the contralateral shoulder. ER1 is not increased in case of glenoid lesion or humeral notch.

Gagey sign: this is positive mainly in case of inferior instability, but may also be positive in isolated labral tear, Bankart lesion, capsule distension or capsule rupture, and does not discriminate between the various glenoid bone lesions.

Sulcus sign in ER1: this is strongly positive in capsule lesion, distension or rupture, but is not responsive to Bankart lesion or bone lesions of the anterior edge of the glenoid cavity.

In posterior instability, there are no specific signs of labral tear, and only signs of posterior instability can be explored: the Gerber posterior stress test, and the jerk test. Posterior drawer may be found. Snapping during these maneuvers raises suspicion of labral lesion (detachment or flap), but is in no way specific [34].

There are thus no clinical signs of labral lesion in unstable shoulder, and only imaging determines lesion and extension.

4.3.2. Treatment

Anterior instability: the present paper is not intended to discuss the optimal surgical technique for anterior instability of the shoulder. The take-home message is that arthroscopy allows reinsertion of detached anterior capsule and labrum and treatment of associated lesions, including superior extension of Bankart capsule-labrum detachment (i.e., mainly SLAP lesions). If bone-block is performed, the anterior labral tear will be resected; any other labral lesion will not be diagnosed and will thus be left.

Posterior instability: after a difficult start with disappointing results, arthroscopic posterior stabilization is now beginning to find a place. Reliability has improved, with results progressively approximating open surgery. In principle, although no evidence has yet been proven, reinsertion by anchorage with suture onto the posterior edge of the glenoid cavity should best reproduce the results of open capsulorrhaphy. As in anterior instability, prognosis depends on associated (especially cartilage) lesions [27].

5. Conclusion

For diagnostic purposes, shoulder arthroscopy better distinguishes between glenoid labrum lesions.

To analyze observational data correctly, it is essential to know normal anatomy, with morphology varying according to sector, and also the classically described variants.

The nosological context also needs to be grasped: stable or unstable shoulder? Single trauma, or iterative microtrauma?

For treatment purposes, neighboring structures should be analyzed, as associated lesions are common: mainly the insertion of the long head of the biceps brachii tendon and glenohumeral ligaments.

The most frequent lesions are SLAP type-II in stable shoulder and Bankart lesion in unstable shoulder.

Disclosure of interest

The author works as a consultant for Mitek and for Tornier.

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